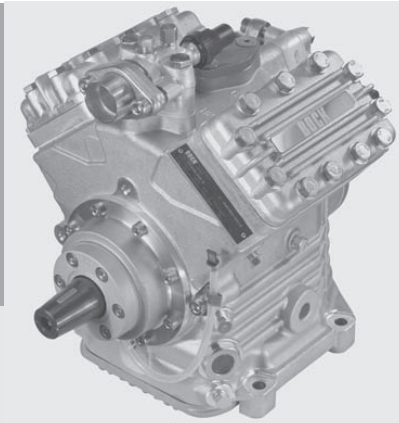
BOCK COMPRESSORS

Betriebsanleitung FK 40
Operating instructions FK 40
Instructions de service FK 40
Istruzioni per l'uso FK 40
Işletme kılavuzu FK 40
使 用 说 明 FK 40



FK 40

Operating instructions

Types:

FK 40/390 N	FK 40/470 N	FK 40/560 N	FK 40/655 N
FK 40/390 K	FK 40/470 K	FK 40/560 K	FK 40/655 K
FK 40/390 TK	FK 40/470 TK	FK 40/560 TK	FK 40/655 TK

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Foreword

Dear Customer,
Bock compressors are top-quality, reliable, service-friendly quality products. Please comply with the following operating and maintenance instructions so that you can benefit from all advantages to the full and use your refrigerating system throughout its entire service life. If you have any questions about installation, operation and accessories, please contact our technical service or your refrigerating system wholesale dealer or our representative. The Bock service team is available by phone under ***+49 7022 9454-0****, by e-mail under* ***mail@bock.de*** *or on the internet under* ***www.bock.de****. In addition, for German speaking countries we have set up a toll-free hotline under* ***00 800 / 800 00 88*** *from Monday to Saturday between 8 a.m. and 9 p.m. Any suggestions you may have regarding the ongoing development of our compressor, equipment and parts programme are welcome at any time.*

QUALITY SYSTEM

certified by DQS according to
DIN EN ISO 9001 : 2000
Reg. No. 2177

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Please read the information summarised for you in this manual before starting work.

It contains important instructions for safety, installation, initial commissioning and handling. In addition you will find information on maintenance, spare parts and accessories.

Some instructions are identified by special symbols with the following meaning:

WARNING This symbol is used to indicate that inaccurate compliance or total failure to comply with the instructions could cause injury to persons or damage to the compressor or refrigerating machine

This symbol indicates important additional instructions which you should observe during your work.

The high quality standard of Bock compressors is guaranteed also by on-going further development of machine, features and accessories. This could possibly result in nonconformities between this present manual and your compressor. Please understand that it is not possible for any claims to be derived from the details, illustrations and descriptions.

Your team at
Bock Kältemaschinen GmbH

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- Subject to modifications -

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Safety

Safety

The Bock refrigerating compressors named in the title are intended for installation in machines (within the EU according to EU directive 98/37/EC Machinery Directive, 97/23/EC Pressure Equipment Directive and 73/23/EC Low Voltage Directive). Initial commissioning is only allowed when the compressor has been installed according to these instructions and the whole machine in which it is integrated has been tested and accepted according to the statutory regulations.

Bock refrigerating compressors have been designed to state-of-the-art engineering. Safety for the user is given particular priority during the design stage. However, it is always possible for the refrigerating machine and operation thereof to pose unavoidable residual risks. **This is why these instructions must be observed carefully by every person working at the compressor.**

Work on the compressor may only be carried out by persons whose technical training, skills and experience together with their knowledge of pertinent regulations and documentation means that they are capable of assessing the work to be carried out and detecting any possible dangers (trained staff as per DIN 31000).

SAFETY INSTRUCTIONS

Caution! Refrigerating compressors are pressurised machines and therefore require particularly careful and meticulous handling.

- **Only qualified staff are allowed to handle refrigerating compressors.**
- **National safety regulations, accident prevention regulations, technical rules and other specifications (incl. EN 378 etc.) must be observed**
- **The compressor may only be operated in refrigerating systems, and only with coolants approved for this compressor by Bock.**
- **The maximum tolerable operating overpressure may not be exceeded (not even for test purposes).**
- **Pressure switches are required to safeguard the machine from excess pressures.**
- **New compressors are provided with an inert gas filling in the factory (approx. 3 bar nitrogen) The pressure in the compressor must be relieved before connecting up the refrigerating system.**
- **Before starting the compressor, check for any signs of transport damage.**
- **Before starting up, check that all components mounted by the user have been properly fitted and are connected pressure-tight with the compressor (e.g. pipelines, bungs, union nuts, replaced parts, etc.)**
- **Before starting up, evacuate the refrigerating machine carefully with the compressor and then fill with coolant.**
- **Before starting the compressor, open the discharge shut-off valve and suction shut-off valve.**
- **Do not start the compressor in a vacuum. Only operate the compressor when the whole system has been filled.**
- **Surface temperatures of more than 100°C are possible on the pressure side respectively below 0°C on the suction side, depending on operating conditions.**

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Product description

Use as intended

This operating manual describes FK40 in the standard version produced by BOCK. The vehicle compressors in series FK40 are designed for **mobile** use (other applications on request).

Short description

Three design variations are available for different areas of application:

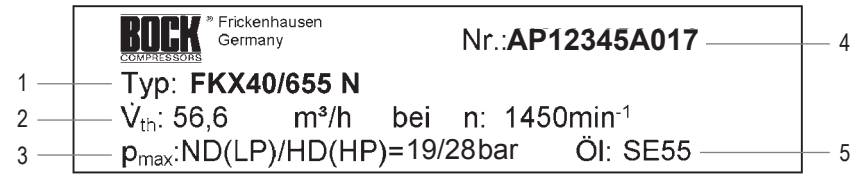
> for air conditioning the **K Design**
> for air conditioning or normal cooling the **N Design**
> for deep freezing the **TK Design**

The differences are mostly associated with the valve plate version which is adapted to each application range where operational safety and efficiency are concerned.

Additional features:

- Compact four-cylinder compressor in V-design
- Low-wearing long-lifed mechanism
- Four sizes
- Light-weight aluminium design
- Crankshaft mounted on either side with roller bearings
- Lubrication oil pump independent of the direction of rotation, with oil relief valve
- Variable arrangement of the shut-off valves
- Ideal valve plate configuration for every working range
- Integrated pulsation damper for extremely quiet running

Nameplate (Exemple)

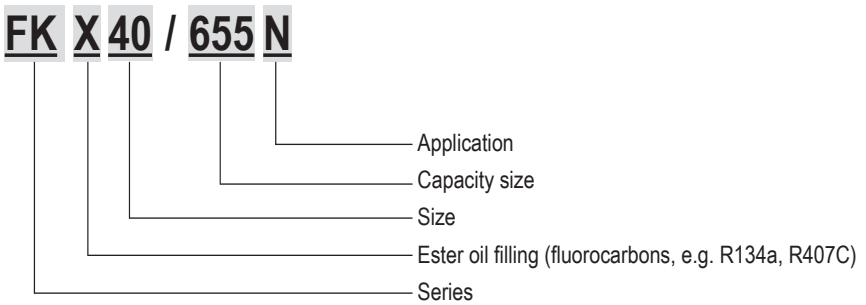


1. Type of compressor
2. Displacement at 1450 rpm
3. LP: max. tol. standstill pressure intake side
   HP: max. tol operating pressure high pressure side
4. Serial number
5. Oil type filled in compressor by the manufacturer

} **note limits of application diagrams!**

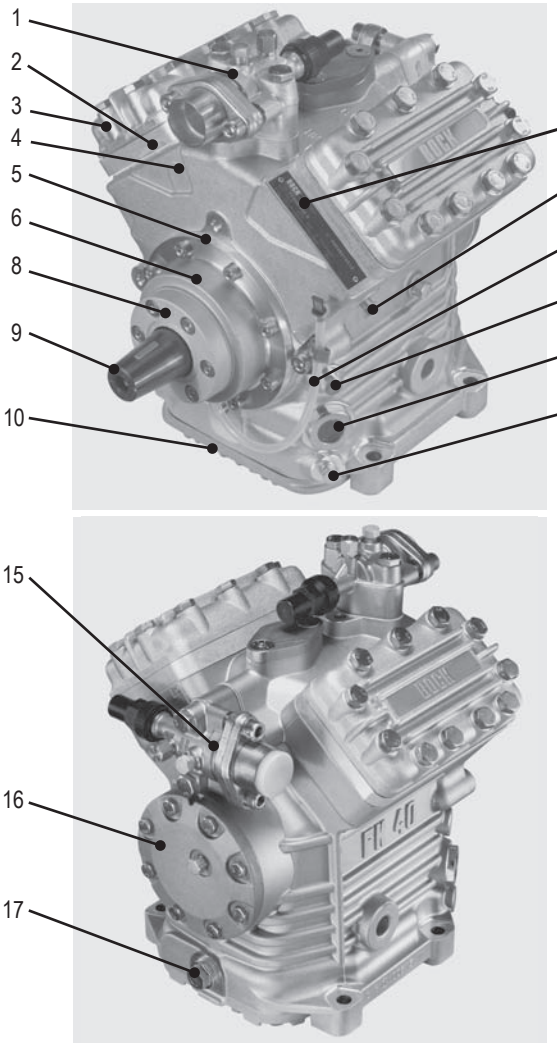
Type key (Example)

Explanation of the type designation



Product description

Main and functional components



1. Discharge shut-off valve
2. Valve plate
3. Cylinder cover
4. Compressor housing
5. Adapter for magnetic clutch
6. Integrated leakage oil collector
7. Leak oil drain hose
8. Axial face seal
9. Shaft end
10. Base plate
11. Connection for heat protection thermostat
12. Oil filler plug
13. Oil sight glasses (2x)
14. Oil drain plug
15. Suction shut-off valve
16. Oil pump
17. Oil drain plug / oil filter
18. Nameplate

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Limits of application

Areas of application

Explanations

It is possible to operate the compressor within the shown diagrams. Please note the significance of the areas shaded in grey. **The application limits must be observed.** The max. discharge temperature of 140 °C and the max. ambient temperature of 100°C may not be exceeded.

Thresholds should not be selected as design or continuous operating points.

- Avoid continuous operation in the limit range. If nevertheless the compressor is used for operation in the limit range, we recommend use of a thermal protective thermostat (accessory).
- Switching frequency: The compressor should not be started more frequently then 12 times per hour, and should not run for less than 2 minutes at a time.
- The limits of application can be altered when using capacity regulators.

N- and K-version

Available models:

- FK 40/390 N
- FK 40/470 N
- FK 40/560 N
- FK 40/655 N
- FK 40/390 K
- FK 40/470 K
- FK 40/560 K
- FK 40/655 K

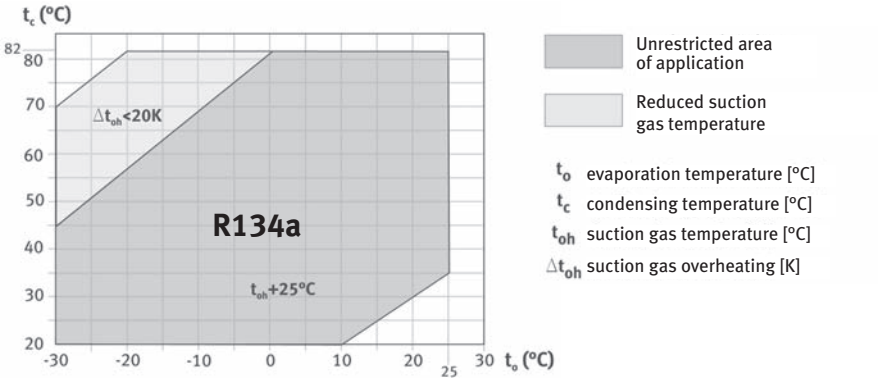
Limits of application R134a (Version N and K)

Speed range:

N-version: 500 - 3000 rpm (peak rotational speed 3500 rpm)

K-version: 500 - 3500 rpm

Max. tol. operating pressure (high pressure side, HD): 28 bar



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Designs for other areas upon request.

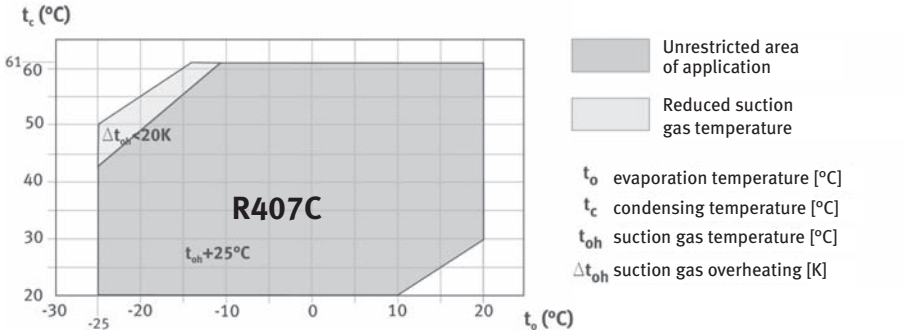
Limits of application

Limits of application R407C (Version N and K)

Speed range:

N-version: 500 - 2600 rpm (peak rotational speed 3500 rpm)
K-version: 500 - 3500 rpm

Max. tol. operating pressure (HP): 28 bar



TK-Version

Available models:

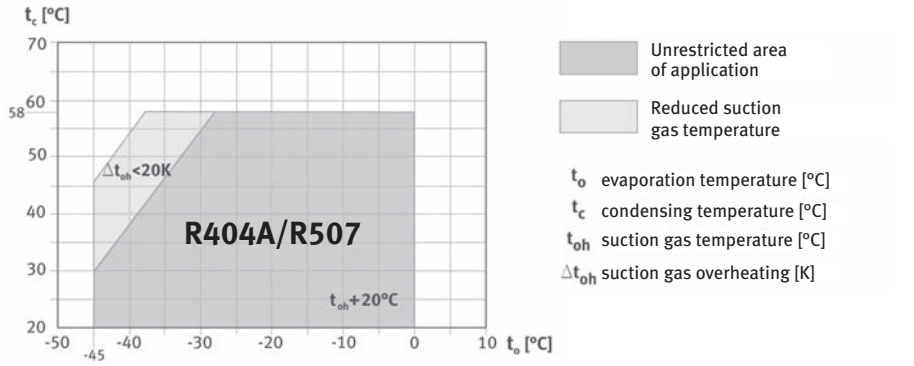
- FK 40/390 TK
- FK 40/470 TK
- FK 40/560 TK
- FK 40/655 TK

Limits of application R404A/R507 (TK version)

Speed range:

TK-version: 500 - 2600 rpm

Max. tol. operating pressure (HP): 28 bar



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Designs for other areas upon request.

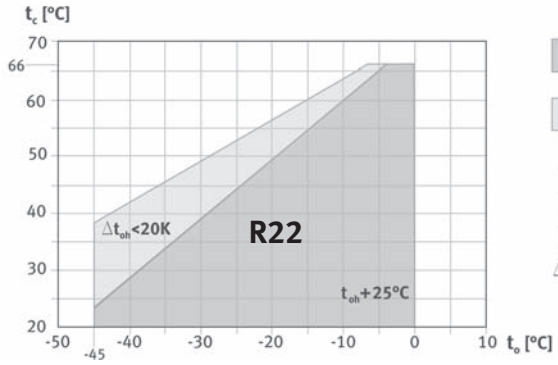
Limits of application

Limits of application R22 (TK version)

Speed range:

TK-version: 500 - 2600 rpm

Max. tol. operating pressure (HP): 28 bar



Unrestricted area of application

Reduced suction gas temperature

t_o evaporation temperature [°C]

t_c condensing temperature [°C]

t_{oh} suction gas temperature [°C]

Δt_{oh} suction gas overheating [K]

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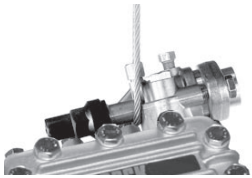
Designs for other areas upon request.

Installation instructions

Mounting the compressor

- Transport and suspension possibilities at the transport eyelet or directly at the pressure shut-off valve.

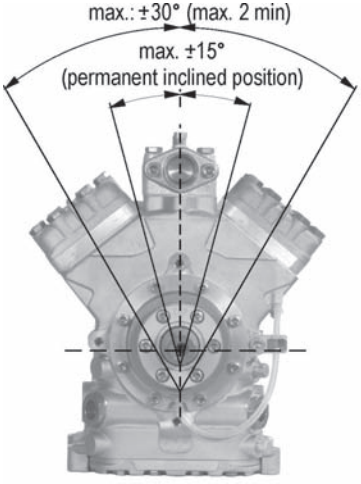


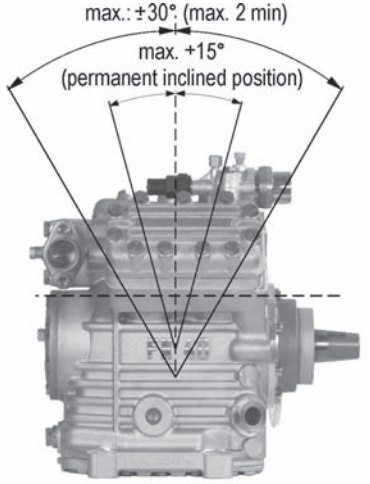
- Bock must be consulted before any other components (e.g. pipe brackets, additional appliances etc.) may be mounted to the compressor
- Proper erection of the compressor and installation of the belt drive play a major role in the running comfort, operating safety and service life of the compressor.

Warning! Compressor is under pressure!
- **Avoid injuries to skin and eyes. Wear goggles!**
- **Leave protective gas filling in the compressor up to evacuation.**
- **Absolutely avoid entry of air!**
- **Do not open shutoff valves up to evacuation.**

Inclined position

Please note the max. tolerable inclined position:





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Belt drive

- Incorrectly executed belt drives, particularly belt hammers or excessive belt tension, can cause damage to the compressor!
- When using capacity regulators (accessories), the changing load can result in increased running noise and vibration of the belt drive.
  Please ensure that the belt drive is designed accordingly (use of tensioning pulleys, selection of belt profile and belt length, etc.)

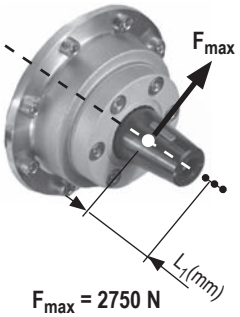
Main bearing load

The following should be observed to avoid overloading of the compressor's main bearing, e.g. by the belt drive:

- The force applied to the point of acting forces (see fig.) may not exceed F_{max} = 2750 N.
- If this point of acting force is moved forward (see fig., small dots) then the force F_{max} is diminished according to the following formula:

$F = 245\ kNmm / (90mm + L_1\ [mm])$

Incorrectly executed belt drives, particularly belt beats due to jumping belts or excessive tensioning forces, can result in compressor damage.

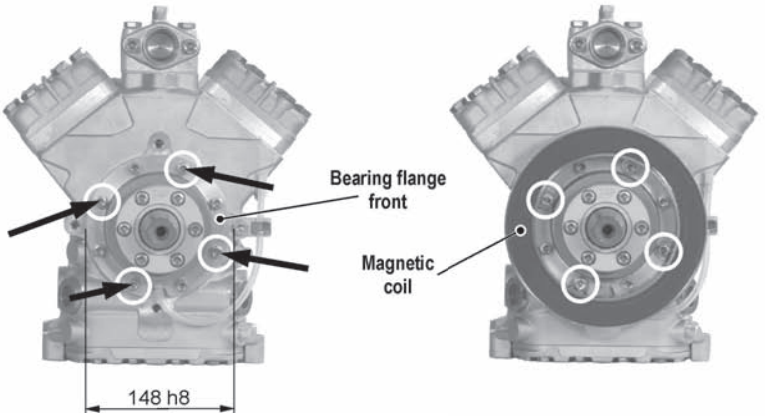


F_{max} = 2750 N
(M_{bmax} = 245 kNmm)

Installation of electromagnetic clutch

The subsequent description applies to an electromagnetic clutch type LA 16 made by Linnig.

- For centering and mounting the magnetic coil of clutch, the front bearing flange has a snug fit of ø148 h8 (see left fig.).
- To install the magnetic coil, unscrew the 4 socket head screws M8 on the bearing flange (see circles and arrows, fig.).
- Mount the magnetic coil on the seat (snug fit), and secure with the four socket head screws M8 (right fig.). Screw tightening torque = 34 Nm.
- Continue with the installation of the electromagnetic coupling according to the instructions of the clutch manufacturer.



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Installation instructions

Pipe connections / pipes

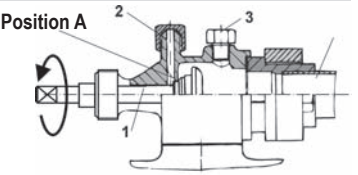
The **pipe connections** are designed in such a way that pipes of all normal metric and inch dimensions can be used. The solder connections of the shut-off should be removed during soldering.

The **pipes and unit components** should always be clean and dry on the inside, and free of cinders, metal chips, rust and phosphate coats. Furthermore the parts, including the hoses, must be delivered sealed air-tight.

Shut-off valves

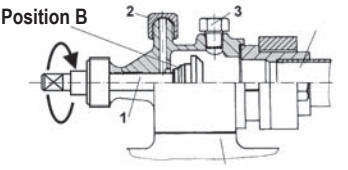
Opening the shut-off valve

a) Open spindle 1: to the left (anti-clockwise) as far as it will go. → Shut-off valve fully opened / service connection 2 closed (setting A),fig.

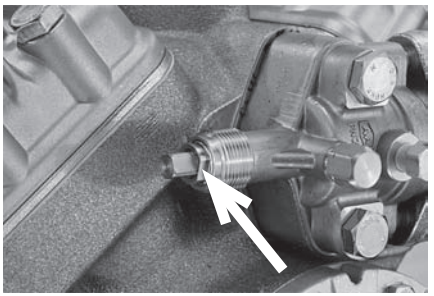


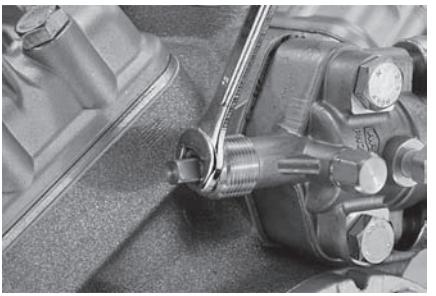
Opening the service connection (2)

b) Turn spindle 1: 1/2 - 1 turn to the right (clockwise). → Service connection 2 opened / shut off valve open (setting B), fig. Connection 3 is for safety purposes and not lockable.



Note: Before opening or closing the shut-off valve, loosen the valve spindle seal (fig. left) 1/4 of a turn. Tighten the valve spindle seal again carefully after activating the shut-off valve (fig. right).





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Initial commissioning

The compressor has undergone trials in the factory and all functions have been tested. There are therefore no special running-in instructions.

Caution! To protect the compressor from intolerable operating pressures, high- and low-pressure pressure gauges are necessary. Please comply with the accident prevention regulations!

Leak test, evacuation

- Check the cooling system for leaks without including the compressor (preferably with dried nitrogen (N_2).
- In the following evacuation procedure, evacuate the system first, then include the compressor in the evacuation procedure:
  - Release pressure in the compressor.
  - Open the suction and discharge shut-off valves.
  - Evacuate the suction and high-pressure side with the vacuum pump. Vacuum < 1.5 mbar with pump switched off.
  - Repeat procedure several times.

Refrigerant filling

- Before filling with refrigerant, check the oil level in the compressor.
- With the compressor switched off, fill in liquid refrigerant into the system (breaking the vacuum) straight into the receiver.
- Start operation of the compressor. If the refrigerant needs topping up after starting the compressor, it can be topped up in vapor form on the suction side.

- **Do not fill liquid refrigerant into the suction shut-off valve on the compressor.**
- **Do not mix additives with the oil or refrigerant.**

Oil level check

Immediately after starting, check the oil level of the compressor.

- Drive motor in operating mode “high idle” (high idle speed).
- The compressor should run for min. 10 minutes.
- The machine should have reached the operating points.
- Check the oil level. In view of the fact that the installation position of the compressor can differ in practice (inclined position), we recommend checking the oil level in both sight glasses. The oil level must be visible in at least one sight glass.
- After the exchange of a compressor the oil level must be controlled again. When the oil level is too high oil must be discharged (danger of oil impacts, less performance of the air conditioning system).

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Initial commissioning

Tightness of the shaft seal

The tightness of the compressor shaft is obtained by an axial face seal (see page 6, fig., item 7). This seal rotates with the compressor shaft.
The following points are **particularly important** for its proper operation:

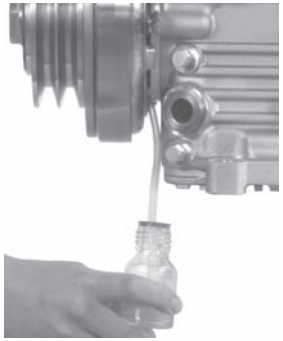
- The entire cooling circuit has to be **expertly built** and its interior must be clean.
- Violent shocks or vibrations on the shaft, as well as **intermittent operation for longer periods have to be avoided.**
- During longer standstill periods (e.g. in the winter), it is possible for the sealing surfaces to stick together. For this reason, **the machine should be started up for 10 minutes about every four weeks.**

Disregard of these directives may cause loss of refrigerant or damage the axial face seal.

- **The axial face seal ensures tightness thanks to the lubricating oil. Small oil losses (a few drops) are thus normal. This is particularly true during the run-in period (200 - 300 h).**
- **The FK 40 is fitted with an integrated leak oil trapping device with oil reservoir for trapping and collecting leaked oil.(see. page 6, fig., item 6).**

Replacement of the axial face seal

As the replacement of the shaft seal requires opening of the refrigerant circuit, it is only recommended if the compressor is really loosing refrigerant. **Emptying the oil reservoir:** The oil reservoir can be emptied very simply without having to dismantle the coupling and/or belt drive. It is recommended that this is done at the same time as the air-conditioning maintenance and motor service. Proceed by removing the oil hose from the bracket, remove the sealing plug and drain the oil into a collecting vessel. After emptying, the oil hose must be resealed and clamped into the bracket. Dispose of used oil in accordance with the regulations applicable in the country of use.



Liquid operation

Liquid operation can damage the compressor and cause leakage of refrigerant.

In order to avoid liquid operation the following points should be **carefully observed:**

- The complete refrigerating plant must be **properly rated and executed.**
- All components of the installation must be **matched to each other in their performance characteristics** (particularly evaporator and expansion valve).
- The suction gas superheat at the outlet of the evaporator should be **at least 7 to 10 K** (check the setting of the expansion valve).
- Machine must reach steady state condition.
- Especially on critical installations, having for example several evaporation points, it is recommended that appropriate measures be taken, such as the use of liquid traps, solenoid valves in the liquid lines etc.

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Maintenance

Safety instructions

Before starting any work on the compressor:

- **Switch off the compressor and secure to prevent unintentional switching on.**
- **Relieve pressure in the compressor.**

After completed maintenance:

- **Connect the safety switch.**
- **Evacuate the compressor.**
- **De-activate the switch-on safeguard.**

Service intervals

To guarantee optimum safety and service life for the compressor, **we recommend** that the following servicing activities and checks be carried out at regular intervals (particularly recommended when the machine is used in the limit range at high temperature and pressure conditions):

- Oil change: Basically it is not vital for the oil to be changed in machines which have been manufactured and are operated correctly. But on the basis of our decades of experience, we recommend the following oil change services:
  - first oil change when servicing the vehicle for the first time
  - then every 5,000 operating hours or at the latest after 3 years,whichever happens first, cleaning the oil filter and the filter intake side at the same time. If necessary, empty the oil reservoir at the rotary seal.
- **Function tests**: **Once per year**, oil level, compressor leak test, operating noise, pressure, temperatures, correct functioning of additional components e.g. capacity regulation.

Recommended spare parts (Please use original Bock spare parts exclusively)

	FK 40/390 N FK 40/470 N	FK 40/560 N FK 40/655 N	FK 40/390 K FK 40/470 K FK 40/560 K FK 40/655 K	FK 40/390 TK FK 40/470 TK	FK 40/560 TK FK 40/655 TK
Designation	Art. No.	Art. No.	Art. No.	Art. No.	Art. No.
Valve plate kit	80240	80241	80010	80240	80241
Set of gaskets	80230		80001	80230	
Set of shaft seals			80023		

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Integrated overcurrent safety valve:

The valve requires no maintenance.

However, abnormal operating conditions can result in constant leaks after blowing off. This can lead to reduced output and increased compressed gas temperature. Check the valve and replace if necessary.

Excerpt from the lubricant table

The oil type filled in the compressor as a standard in the factory is indicated on the **nameplate**. **This oil type should be given preference**, other oil types are listed in the following excerpt from our lubricant table.

Maintenance

Lubricants

Bock standard oil grade	Recommended alternatives	
for H-CFCs (e.g. R22)		
FUCHS Reniso SP 46	MOBIL SHC 425 SHELL Clavus SD 22-12 SUNOIL Suniso 3 GS	SUNOIL Suniso 4 GS TEXACO Capella WF 46
for fluorocarbons (e.g. R 134a, R404A, R407C)		
FUCHS Reniso Triton SE 55	FUCHS SEZ 32 / 68 / 80 ICI Emkarate RL 46 S	MOBIL Arctic EAL 46 SHELL Clavus R 46

Information about other suitable supplementary or substitute oils is available in the Bock lubricant tables.

Caution! The oils are to be checked for suitability according to the operating conditions and refigerants.

Screwed unions

Various installation, maintenance and servicing work entails intervention in the compressor. All work must therefore be performed with strict compliance with the given safety instructions. The following torques must be used when re-assembling the compressor

Cylinder cover	M10	60 Nm
Axial face cover	M8	37 Nm
Connecting rod	M6	15 Nm
Oil drain screw	M22 x1,5[1)]	70 Nm
Oil filler plug	1/4“ NPTF	25 Nm
Flange connection Soldered connection shut-off valve	M10	60 Nm
Electromagnetic clutch	M12	85 Nm
Safety valve	M24 x 1,5	70 Nm

[1)] Screw with aluminium seal

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Notes: Cylinder head/valve plate: tighten screws from the middle outwards crosswise in at least two stages (torque 50/100%).

Decommissioning

For major repairs or when decommissioning:

Comply with the safety instructions on page 15! Close the shut-off valve on the compressor, vacuum out the refrigerant (do not blow out!) and dispose of correctly. Open the screwed unions or flanges at the compressor valves and remove the compressor using hoisting gear if necessary. When scrapping the compressor, drain the oil and dispose of correctly. Comply with the national regulations!

WARNING! Compressor is under pressure! Avoid injures to skin and eyes. Wear goggles!

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Accessories

Capacity regulation

Compressor type	Special accessory 12 V Art. No.	Special accessory 24 V Art. No.
FK 40 / ... N und FK 40 / ... TK	08703	08704
FK 40 / ... K	08708	08709

For detailed description please also refer to technical information “Capacity Regulation“ (Art. No. 09900). When installed in the factory, the capacity regulator is integrated in a specially designed cylinde cover. When retrofitted, it is supplied together with the cylinder cover. The regulator controls a bank of cylinders (capacity reduction approx. 50%).

- **Capacity regulated operation changes the gas velocities and pressure ratios in the refrigerating system: adjust the routing and rating of the suction line accordingly, adjust the regulation intervals so that these are not too short, do not switch more frequently than 12 times per hour (refrigerating system must reach equilibrium). We do not recommend continuous operation in the capacity regulation mode.**
- **Electrical control of the solenoid: disenergized open (corresponds to 100% compressor capacity).**
- **Cylinder covers for capacity regulation are marked with „CR“ (Capacity Regulator).**

Heat protection thermostat (Special accessory - can also be retrofitted, Art. No. 07595)

On the hot gas side of the compressor housing there is a connection for the sensor element (page 6, fig., item 10). The heat protection thermostat is to be connected in series with the control line.

Technical specifications:

Switching voltage max.:	24 V DC
Switching current max.:	2.5 A at 24 V DC
Cut off temperature :	145°C ± 5 K
Cut on temperature :	approx. 115°C

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Specifications, connections

Technical specifications

Type	Nr. of cyl.	Swept volume cm^3	Theor. displacement (1450 rpm) m^3/h	Weight kg	Connections: Discharge side HP mm / Inch	Connections: Suction side LP mm/Inch	Oil filling Ltr.
FK40/390	4	385	33,5	34	22 / $^7/_8$	28 / 1 $^1/_8$	2,0
FK40/470		465	40,5	33	28 / 1 $^1/_8$	35 / 1 $^3/_8$	2,0
FK40/560		555	48,3	33	28 / 1 $^1/_8$	35 / 1 $^3/_8$	2,0
FK40/655		650	56,6	31	35 / 1 $^3/_8$	35 / 1 $^3/_8$	2,0

Inertia moment of the driving unit [kgm^2]: 0,0043
Lubrication: Forced lubrication
Oil pump: oil pump independent of sense of rotation

Connections

A	Suction side connection, not lockable	1/8“ NPTF
A1	Suction side connection, lockable	7/16“ UNF
B	Discharge side connection, not lockable	1/8“ NPTF
B1	Discharge side connection, lockable	7/16“ UNF
C	Oil pressure safety switch connection OIL	1/8“ NPTF
D	Oil pressure safety switch connection LP	1/8“ NPTF
E	Oil pressure gauge connection	1/8“ NPTF
F	Oil drain plug	1/4“ NPTF
G	Opt. connection for oil sump heater[1)]	M22 x 1.5
H	Oil charge plug	1/4“ NPTF
K	Sight glass	2 x 1 $^1/_8$“-18 UNEF
L	Connection thermal protection thermostat	1/8“ NPTF
M	Oil filter	M22 x 1.5
SV1	Opt. pos. of connection for suction line valve	--

[1)] = Only possible ex factory

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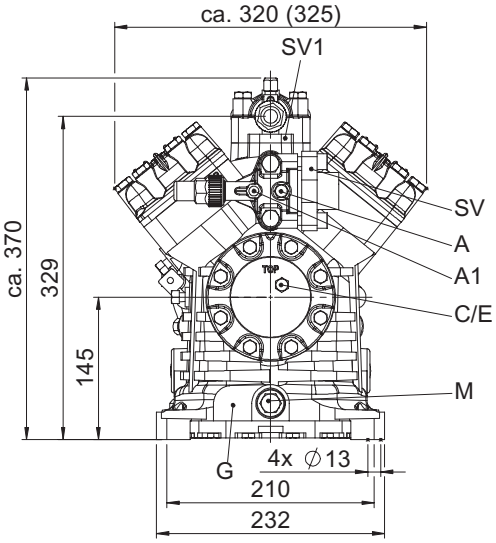
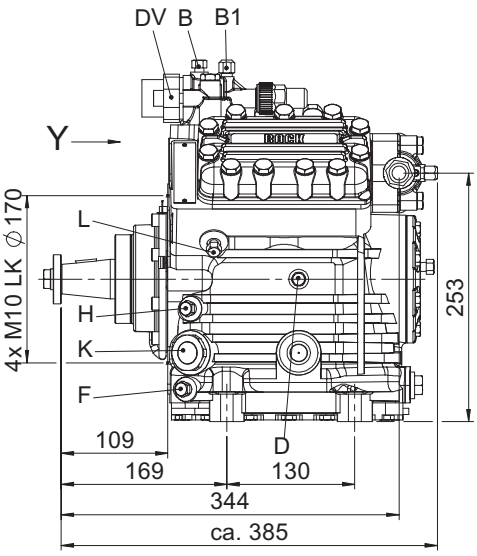
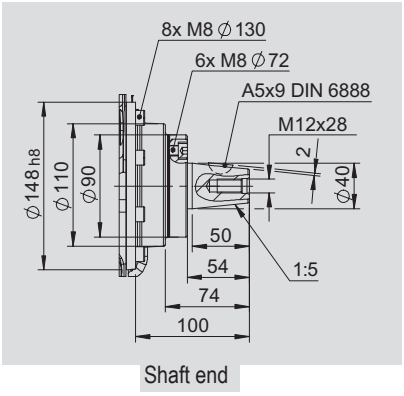
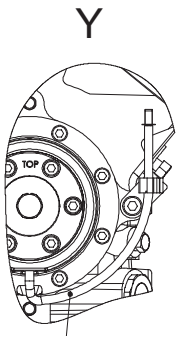
Dimensions







Shaft end



Leak oil drain hose

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Manufacturer declaration

MANUFACTURER DECLARATION
for use of the compressors within the European Union
(refering to the EU machinery directive 98/37/EEC, annex II B)

We herewith declare that the refrigerating compressors named in the title in the version supplied by us are intended for installation in a machine which complies with the machinery directive 98/37/EEC.

Applied harmonised standards

EN ISO 12100-1	EN 349	EN 60529
EN ISO 12100-2	EN 60204-1	

It is however not permitted to start up our products before the machine in which they are integrated has been tested according to the corresponding statutory regulations and declared to be conforming in all points.

Frickenhausen, 17.05.2004

Dr. Harald Kaiser
Technical Director

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